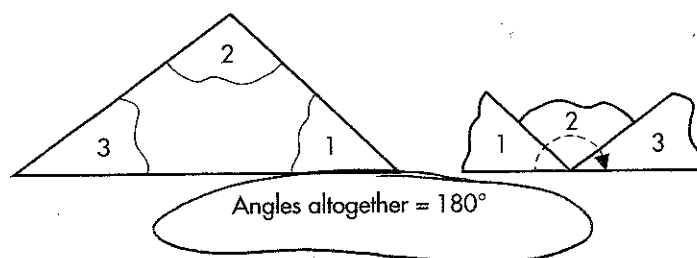


Some students may say that all triangles have  $180^\circ$  inside. If students suggest this, ask them to explain how they know or to show you what they mean. If they can't, you might demonstrate this way: Start with any paper triangle, tear off the three angles, and line them up to prove they form a straight line, or  $180^\circ$ . You can use the same method later to show that the angles of a quadrilateral add up to  $360^\circ$ .



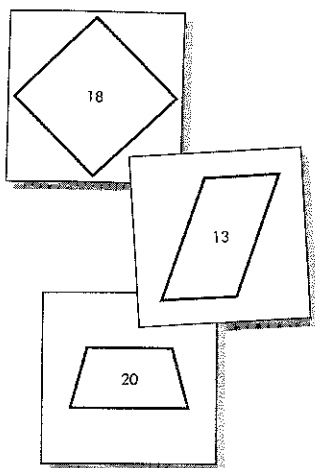
When students have run out of ideas for attributes of triangles, post the list and tell them you will continue to add to the list throughout the unit as they come up with more ideas.

## Activity

### Identifying Quadrilaterals

Student pairs take out their decks of Guess My Rule Cards and sort out all the four-sided shapes. (There are 15 four-sided polygons in the deck, shapes 13 through 27.) Ask if there is a single name we can use for all these shapes. As necessary, remind students of the chart the class made in Session 1 that lists the names of polygons by number of sides.

\*Some students may think the name for four-sided shapes should be *squares* or *rectangles*. Encourage them to look for four-sided shapes that are not squares or rectangles so they can be convinced that other quadrilaterals exist and that squares, rectangles, and all other four-sided shapes are quadrilaterals, just as all three-sided shapes are triangles.



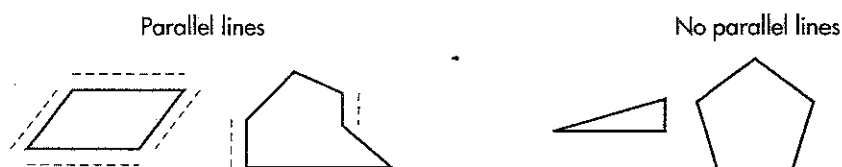
**Parallel Sides** Place a loop of string on the overhead screen or display the transparency with a circle on it. Then place inside the loop three or four of the quadrilaterals with at least one pair of parallel sides (13, 16, 18, 20, and 21–27). As you place them, intentionally orient the parallel sides in different ways. Leave the other quadrilaterals scattered in a pool.

The quadrilaterals I have put inside the loop have something in common. Instead of guessing what the rule is, name the numbers of another shape that you think might fit my rule. If I place that shape in the loop, it fits the rule. If I put it outside the loop, it does not fit the rule. Keep track with your own cards at your desks. Make a group of shapes that fit and set aside those that do not.

As students suggest shapes, stop them from guessing the rule out loud until it seems that many of them know it. When students finally state the rule, ask them to tell you which sides in these shapes are parallel, and to describe what *parallel* means.

Parallelism is a notoriously difficult concept for children. Many students will have difficulty seeing that two lines can be parallel when they are not directly across from each other. Through discussion, try to generate a classroom definition. You might suggest that students think of *parallel* as meaning “going in the same direction,” or compare parallel lines to train tracks.

Sketch on the board some examples of figures with parallel lines, as well as some with no parallel lines. Ask students to point out the lines that are parallel or to demonstrate that the lines are parallel or not.



## Activity

Using the set of quadrilaterals on the Guess My Rule Cards, students now find other ways to categorize them (just as they did earlier with triangles). They record their categories on notebook paper, along with the numbers of the shapes that fit each category.

Again, record students' categories on chart paper, with numbers and sketches of the shapes that fit each category.

To encourage students to compare categories, you might ask them what shapes appear in many categories (shapes 18 and 21), and why that is so. This is a chance for students to discuss such questions as whether all squares are rectangles and all rectangles squares. The **Dialogue Box**, *Are Squares Rectangles?* (p. 45), illustrates one class discussion of this question.

## Sorting Quadrilaterals

Categories		
#1	All rectangles	24
#2	All even sides	18, 27, 23, 21
#3	Slanted sides	26, 13, 23

## Activity

### Attributes of Quadrilaterals

Just as you did with triangles, set up two lists on chart paper headed *All quadrilaterals...* and *Some quadrilaterals...*

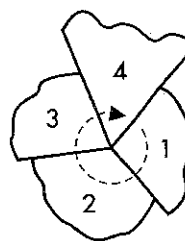
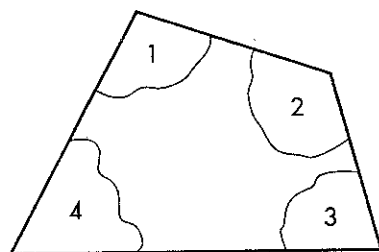
How many sides in a quadrilateral? Do *all* quadrilaterals have four sides? [Record this fact under "*All quadrilaterals...*"] What else do all quadrilaterals have to have?

What are some of the differences among quadrilaterals? Look at the shapes, and think about the categories you came up with for sorting them. How can we complete the statement, "Some quadrilaterals have..."?

What is true of the sides of some quadrilaterals? What kinds of angles do some quadrilaterals have?

List the attributes students mention. Ask them to give the numbers of quadrilaterals that have the attribute they suggest, or draw one on the board. If they can name the shape specifically, record the name with the related attribute.

If students say a quadrilateral has  $360^\circ$  inside, ask them to explain how they know or to show what they mean. If they can't, demonstrate as you did for triangles, by tearing angles from paper quadrilaterals and arranging them to prove they form a full circle, or  $360^\circ$ .



Angles altogether =  $360^\circ$

#### All quadrilaterals...

- have 4 lines, segments, or sides
- have no rounded corners, no crossing lines (are polygons)
- have angles that add up to  $360^\circ$
- can have different shapes and sizes (don't have to be perfect)
- have 4 angles, corners, points, or vertices

#### Some quadrilaterals...

- have a right (or  $90^\circ$ ) angle or turn (are perpendicular)
- have parallel lines (going in the same direction, equidistant from each other)
- have all equal sides (square or rhombus)
- have 2 sides parallel and other 2 sides parallel (parallelogram)
- have no sides the same (nonregular)
- have acute angles and obtuse angles

Continue to add to this list as students come up with more ideas about quadrilaterals. Be sure students understand they are not restricted to thinking about the shapes included in the Guess My Rule Cards. Encourage them to find and draw examples of quadrilaterals (and also triangles) that are not represented on the cards. Can they find the names for any of these special quadrilaterals and triangles?

## Activity

### Playing Guess My Rule

Students play Guess My Rule in groups of three or four, using a full deck of Guess My Rule Cards. For the rules they present to each other, they try to find attributes of triangles and quadrilaterals beyond those that have been listed in class, and attributes of other polygons pictured on the cards.

To start, one student (or pair) is the leader. The leader decides on a rule, writes it on a piece of paper, and keeps it hidden.

❖ **Tip for the Linguistically Diverse Classroom** When students who are less proficient in English are the leaders, they can illustrate their rule with a drawing rather than writing it out. They might label their drawing with numbers, symbols (such as the equals sign), and other designations.

Each group uses a piece of paper as a “loop” for categorizing. The leader indicates a few shapes that fit the rule and a few that don’t, placing those that fit on the paper, those that don’t to one side (off the paper). Without guessing the rule aloud, other players take a new shape and place it on or off the paper to show whether they think it follows the rule. The leader tells whether that placement is correct or not.

No one may guess the rule aloud until everyone has had a chance to try out several shapes, or until there are no shapes left. After one round, the group plays again with a new leader.

As they play, groups list the categories they have used. If students would like more shapes to play with, they might take one of each shape from the Power Polygons.

Circulate to be sure everyone understands the game and that all students are participating.

**Follow-Up Discussion** Toward the end of Session 3, call the class together to share some of the new categories students used in Guess My Rule, showing examples of each. This is another chance for you to introduce precise vocabulary and to add to the lists of *Some triangles....* and *Some quadrilaterals....*

Name

Date

**Student Sheet 10****Can You Make These Quadrilaterals?**

	Length of sides	Angles	Number of parallel sides	Name of shape	Setxy points that make this quadrilateral	Sketch of Power Polygons that make this quadrilateral
quad1	2 pairs of equal sides	4 right angles	2 pairs			
quad2	4 equal sides	0 right angles	2 pairs			
quad3	0 equal sides	4 right angles	your choice			
quad4	your choice	exactly 2 right angles	1 pair			
quad5	your choice	your choice	0 pairs			

Do you think any of these quadrilaterals are impossible?  
If so, pick one and write about how you could prove it is impossible.

## Classifying Quadrilaterals

### Introduction

**Objective** → Students will be able to identify trapezoids, parallelograms, rhombi, rectangles, and squares.

**Context** → Students have had previous experiences with two-dimensional shapes. They will go on to learn more about the properties of the shapes.

### NCTM Standards Focus

The introduction of different types of quadrilaterals and their corresponding characteristics or properties lays the foundation for students' subsequent studies in geometry. In this standards-based lesson, students build their knowledge and understanding from the ground up. They make drawings of quadrilaterals and use these to learn and understand the different properties of the various types of quadrilaterals.

**Reasoning and Proof** Students apply their knowledge of the various characteristics or properties of different types of quadrilaterals. They use their drawings of figures to determine whether they agree or disagree with statements made about these quadrilaterals.

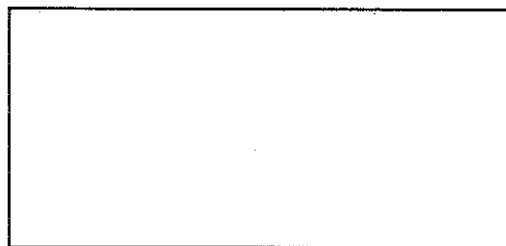
**Communication** Students work cooperatively to create different quadrilaterals. They discuss the characteristics of their shapes and determine whether or not they represent a particular type of quadrilateral. They communicate their ideas both orally and in writing.

**Representation** Students create figures based on general information about these figures. They also use the representations to make generalizations about the figures.

### Teaching Plan

**Materials** → Student pages 74–75; 2-cm grid paper; rulers

**B**EGIN THE LESSON by asking students if they know what a quadrilateral is. Point out that the prefix *quad-* means “four” and *lateral* means “sides.” A quadrilateral is any shape that has four sides. *What are some shapes that you know are quadrilaterals?* (Square, rectangle, parallelogram, kite, diamond, rhombus, trapezoid) Draw a rectangle on the overhead or board. Ask students to list the characteristics of the figure.



**What Students Might Say**

- There are two pairs of parallel sides.
- The pairs of opposite sides are the same length (congruent).
- All the angles are right angles.

Introduce or reinforce the vocabulary words *parallel*, *congruent*, and *right*. Define the terms by referring back to the figure, connecting the terms to their representations. This will give students a visual reference to use as they describe their own figures later in the lesson. Since students will be expected to use this vocabulary during the lesson, be sure they are comfortable with these terms before proceeding with the lesson.

PASS OUT A SHEET of 2-cm grid paper and a ruler to each student. Have students work in pairs to draw as many different four-sided <sup>polygons</sup> figures as they can. Tell them that it is acceptable to draw any four-sided figure. After students have at least ten figures, tell them to stop. Have them select ten different figures and number them 1–10.

Give a copy of student page 74 to each student. Explain to students that they are to complete this chart, using the 10 figures they've selected. You may want to demonstrate how to complete one entry using your figure or a figure from one of the student pairs.

**f.y.i.**

Have students write these terms and their meanings in their math journals or on a 3 × 5 card for easy reference. These may or may not be terms that students are familiar with. They will be needed for the remainder of the lesson.

### What Might Happen . . . What to Do

Some students may be concerned that there are no columns for zero parallel lines, right angles, or congruent sides. Make sure they understand that if there are no check marks for a figure, there are no parallel lines, right angles, or congruent sides. You may also

want to go over the section on the congruent sides. The first column means there is one pair of congruent sides, the second means there are two different pairs of congruent sides and the third means all sides are congruent.

**f.y.i.**

---

As the discussion continues, encourage students to note that despite variations of other attributes, quadrilaterals always have 4 sides.

**f.y.i.**

---

Point out to students that in #5 on student page 75, the word *rhombi* is the plural form of *rhombus*.

When students have finished, bring them together as a class to discuss their findings. Ask if someone has a figure for which columns A and E are checked. If more than one student has the same columns checked, have the class look at the differences and the similarities in the figures. Looking at different figures with similar attributes will help students clarify their understanding of the attributes. As students talk about their shapes, encourage them to name the shapes (square, rectangle, etc.). Continue the discussion, letting students show their figures and describe the figures' attributes until you think students have a good understanding of the characteristics of quadrilaterals.

Now have students complete the bottom of page 74. You may wish to begin with a class discussion in which students tell what they know about each figure and reach a class description of the attributes or characteristics of the figures. Encourage students to include attributes of both sides and angles for each figure. See the *Answers* section of the lesson for a suggested list of attributes.

Once students have recorded the characteristics of the five types of quadrilaterals, have them look back at their 10 figures. *Do you have any figures of these types? Which ones? Do any of your figures meet the characteristics for more than one type? Which figures and which types?* Engage students in a discussion about their figures. Challenge them to explain how one figure can fit into more than one category of quadrilaterals.

**CLOSE THE LESSON** by telling students they will be using what they have learned to make some general statements about these types of figures.

Depending on the amount of time you have, you may either have students do page 75 in class or later. Tell students they should refer to the figures they drew and analyzed earlier in the lesson.



## Student Pages

Student page 74 provides a chart with various characteristics for students to check off as they pertain to the quadrilaterals they drew. The page also provides space to describe the characteristics of various quadrilaterals. Student page 75 gives students opportunities to make generalizations about quadrilaterals.

## Assessment

You had an opportunity to observe students' understanding as they analyzed their figures and discussed how their figures fit into the charts. Page 75 gave an opportunity to assess students' overall understanding of the figures.

## NCTM Standards Summary

Students created multiple representations of quadrilaterals and explored their characteristics, noting characteristics that different quadrilaterals shared. Students used their observations to list the characteristics of various types of quadrilaterals. Finally, they made generalizations about the figures. They communicated their reasoning orally in small group and whole class discussions, as well as in writing.

## Answers

### Page 74

1. Answers may vary.
- 2–6. Answers may vary, but should include the following characteristics:  
 Square: 4 sides of equal length;  
 4 right angles;  
 Rectangle: opposite sides are parallel and of equal length;  
 4 right angles;  
 Parallelogram: opposite sides are parallel and of equal length;  
 Rhombus: opposite sides are parallel; all sides are of equal length;  
 Trapezoid: one pair of parallel sides.

### Page 75

1. Disagree; Rectangles have opposite sides of equal length, while squares must have *all* sides of equal length.
2. Agree; A square meets the definition of a rhombus, but a rhombus does not need to have four right angles.
3. Disagree; A trapezoid needs only one pair of parallel sides. It is possible for a trapezoid to have four different angles.
4. Disagree; A quadrilateral needs only four sides and four angles.
5. Agree; All rhombi have pairs of opposite sides that are parallel and of equal length.

# Classifying Quadrilaterals

① Place a check mark in each column that applies to the figures you've drawn.

	A	B	C	D	E	F	G
Figure	1 pair of parallel sides	2 pairs of parallel sides	2 right angles	4 right angles	1 pair of congruent sides	2 pairs of congruent sides	4 congruent sides
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							

Describe the characteristics of each shape.

- ② Square \_\_\_\_\_
- ③ Rectangle \_\_\_\_\_
- ④ Parallelogram \_\_\_\_\_
- ⑤ Rhombus \_\_\_\_\_
- ⑥ Trapezoid \_\_\_\_\_

# Classifying Quadrilaterals

For each statement, circle *Agree* or *Disagree*. Explain your reasoning.

- ① All rectangles are squares. Agree Disagree

---

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- ② All squares are rhombi, but not all rhombi are squares. Agree Disagree

---

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---

- ③ All trapezoids have two pairs of congruent angles. Agree Disagree

---

---

---

- ④ All quadrilaterals have at least one pair of parallel sides. Agree Disagree

---

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---

- ⑤ All rhombi are parallelograms. Agree Disagree

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---

---

Name \_\_\_\_\_

## Classify Quadrilaterals

**Essential Question** How can you use sides and angles to help you describe quadrilaterals?

COMMON CORE STANDARD CC.3.G.1

Reason with shapes and their attributes.

### UNLOCK the Problem

Quadrilaterals are named by their sides and their angles.

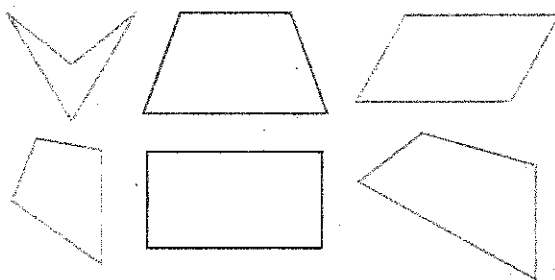


**Describe quadrilaterals.**

**quadrilateral**

\_\_\_\_\_ sides

\_\_\_\_\_ angles



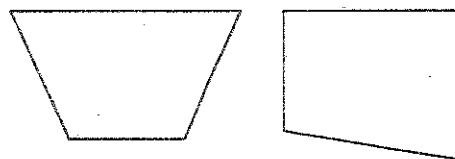
### ERROR Alert

Some quadrilaterals cannot be classified as a trapezoid, rectangle, square, or rhombus.

**trapezoid**

exactly \_\_\_\_\_ pair of opposite sides that are parallel

lengths of sides could be the same

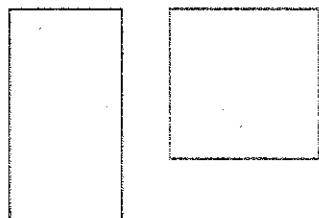


**rectangle**

\_\_\_\_\_ pairs of opposite sides that are parallel

\_\_\_\_\_ pairs of sides that are of equal length

\_\_\_\_\_ right angles

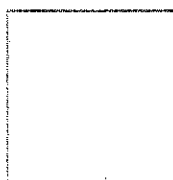


**square**

\_\_\_\_\_ pairs of opposite sides that are parallel

\_\_\_\_\_ sides that are of equal length

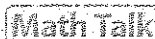
\_\_\_\_\_ right angles



**rhombus**

\_\_\_\_\_ pairs of opposite sides that are parallel

\_\_\_\_\_ sides that are of equal length



**Math Talk** Explain why a square can also be named a rectangle or a rhombus.

MATHEMATICAL PRACTICES



Look at the quadrilateral at the right.

- Outline each pair of opposite sides that are parallel with a different color. How many pairs of opposite sides appear to be parallel?

- Look at the parallel sides you colored.

The sides in each pair are of \_\_\_\_\_ length.

- Name the quadrilateral.

Circle all the words that describe the quadrilateral.

4.



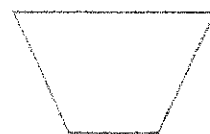
rectangle  
rhombus  
square  
trapezoid

5.



rhombus  
quadrilateral  
square  
rectangle

6.



rectangle  
rhombus  
trapezoid  
quadrilateral

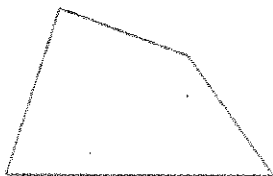
**Math Talk**

Explain how you can have a rhombus that is not a square.

**On Your Own**

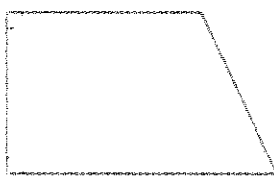
Circle all the words that describe the quadrilateral.

7.



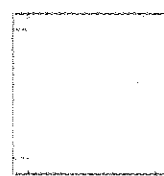
rectangle  
trapezoid  
quadrilateral  
rhombus

8.



rectangle  
rhombus  
trapezoid  
square

9.



quadrilateral  
square  
rectangle  
rhombus

Name \_\_\_\_\_

## Problem Solving.....

Use the quadrilaterals at the right for 10–12.

10. Which quadrilaterals appear to have 4 right angles?

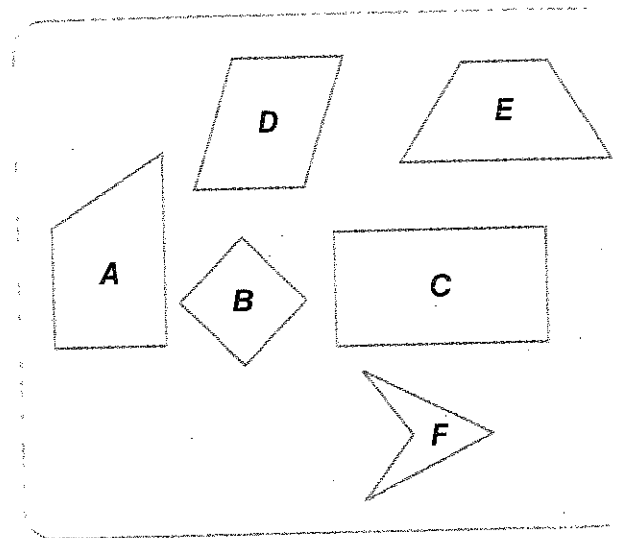
\_\_\_\_\_

11. Which quadrilaterals appear to have 2 pairs of opposite sides that are parallel?

\_\_\_\_\_

12. Which quadrilaterals appear to have no right angles?

\_\_\_\_\_



Write *all* or *some* to complete the sentence for 13–18.

13. The opposite sides of \_\_\_\_\_ rectangles are parallel.

14. \_\_\_\_\_ sides of a rhombus are the same length.

15. \_\_\_\_\_ squares are rectangles.

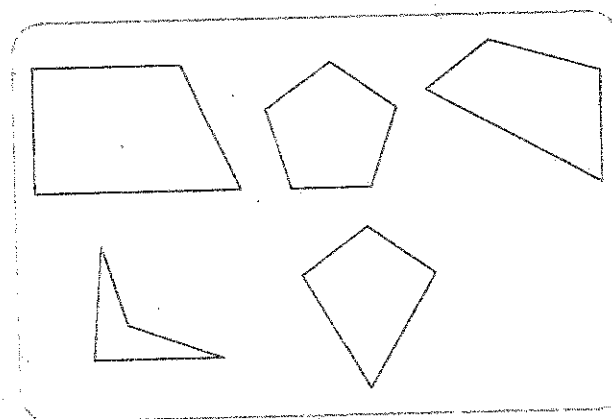
16. \_\_\_\_\_ rhombuses are squares.

17. \_\_\_\_\_ quadrilaterals are polygons.

18. \_\_\_\_\_ polygons are quadrilaterals.

19. **Write Math** Circle the shape at the right that is not a quadrilateral. Explain your choice.

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

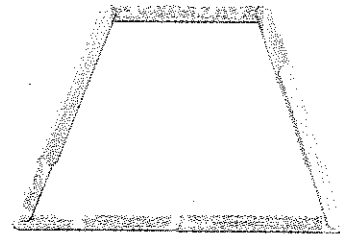


20. **H.O.T.** I am a polygon that has 4 sides and 4 angles. At least one of my angles is less than a right angle. Circle all the shapes that I could be.

quadrilateral   rectangle   square   rhombus   trapezoid

21. ☆ Test Prep Rita glued craft sticks together to make this shape. Which best describes the quadrilateral Rita made?

Ⓐ square Ⓑ rectangle Ⓒ rhombus Ⓓ trapezoid

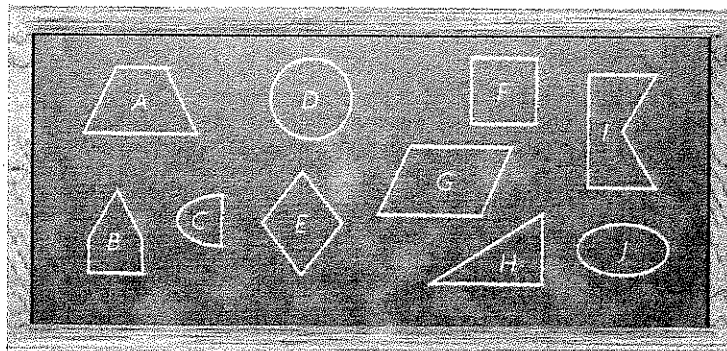


### Connect to Reading

#### Compare and Contrast

When you *compare*, you look for ways that things are alike. When you *contrast*, you look for ways that things are different.

Mr. Briggs drew some shapes on the board. He asked the class to tell how the shapes are alike and how they are different.



#### Complete the sentences.

- Shapes \_\_\_\_\_, \_\_\_\_\_, \_\_\_\_\_, \_\_\_\_\_, and \_\_\_\_\_ are polygons.
- Shapes \_\_\_\_\_, \_\_\_\_\_, and \_\_\_\_\_ are not polygons.
- Shapes \_\_\_\_\_, \_\_\_\_\_, \_\_\_\_\_, and \_\_\_\_\_ are quadrilaterals.
- Shapes \_\_\_\_\_, \_\_\_\_\_, and \_\_\_\_\_ appear to have only 1 pair of opposite sides that are parallel.
- Shapes \_\_\_\_\_, \_\_\_\_\_, and \_\_\_\_\_ appear to have 2 pairs of opposite sides that are parallel.
- All 4 sides of shapes \_\_\_\_\_ and \_\_\_\_\_ appear to be the same length.
- In these polygons, all sides do not appear to be the same length.
- These shapes can be called rhombuses.
- Shapes \_\_\_\_\_ and \_\_\_\_\_ are quadrilaterals, but cannot be called rhombuses.
- Shape \_\_\_\_\_ is a rhombus and can be called a square.